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**U.S. Department of  
Transportation**

**National Highway  
Traffic Safety  
Administration**



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# **Highway Safety Literature**

**... A SEMI-MONTHLY ABSTRACT JOURNAL**

**73-14**

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A document containing several articles is announced as complete volume under an HS number referring to it as a whole. Entries for individual articles are listed under their own HS numbers.

## SAMPLE ENTRIES

<b>JOURNAL ENTRY</b>	<b>Title of Document</b>	<b>SYNTHESIS OF CASE LAW JURISPRUDENCE RELATING TO WET-WEATHER HIGHWAY CONDITIONS</b>
	<b>Journal Citation</b>	Highway Research Record n 376 p29-36 (1971)
<b>CONTRACT REPORT</b>	<b>Author(s)</b>	D. C. Oliver 1971 Sponsored by Highway Res. Board Steering Com. for Workshop on Anti-Skid Program Management and presented at the workshop.
	<b>Search Terms</b>	Descriptors: *Liability, *Negligence, *Accident responsibility, *Legal responsibility, *Wet road conditions, *Court decisions, *State government, *Skidding accidents, *Warning signs, *Highway maintenance, *Litigation, *Icy road conditions,
<b>CONTRACT REPORT</b>	<b>Abstract</b>	The extant case law on legal liability for accidents occurring on icy and wet highways has established three central areas and one subarea in the jurisprudence of maintenance liability. These areas are compliance with general duties in order to escape liability; damages resulting from noncompliance (negligence); contributory negligence as a bar to recovery; and advisory signing as a technique in meeting general duties. Court decisions covering these four areas are presented.
	<b>NHTSA Accession Number</b>	HS-012 289 *Subject heading in Subject Index

## EQUIPMENT AND PROCEDURES FOR MEASURING GLARE FOR MOTOR VEHICLES. FINAL REPORT

<b>Corporate author</b>	Teledyne Brown Engineering N. E. ChattertonJ. D. HayesE. W. George 1972 102p Contract DOT-HS-089-1-139
<b>Availability</b>	Descriptors: *Glare, *Glare reduction, *Visual perception, *Photometers, *Luminance, *Hydraulic equipment, *Central vision, *Field of view, *Backgrounds, *Contrast, *Light conditions, *Brightness, *Test facilities, *Test equipment, *Vehicle safety standards, *Simulators, *Light, *Reflectance, *Measuring instruments,  A procedure and description of equipment for measuring glare from a driver's own vehicle are presented. The procedures are based on a disability glare theory as applied to foveal vision. Two pieces of apparatus were constructed to provide the measurement capability. One of them simulates diffuse sky glare and the other simulates direct solar glare. Methods of combining data from these measurements are presented along with scaling laws selected to provide a value for glare as it would be under natural daylight conditions. A standard for allowable glare levels from the vehicle is developed which is independent of the measurement procedure. Test results from a passenger car are presented and compared with this standard. Recommendations for improvements to the apparatus and additional research requirements for improvement to the theory are made.

## **1. ACCIDENTS**

### **1A. Emergency Services**

#### **AMERICAN ASSOCIATION FOR AUTOMOTIVE MEDICINE CONFERENCE (16th) PROCEEDINGS, CHAPEL HILL, NORTH CAROLINA, OCTOBER 19-21, 1972**

American Assoc. for Automotive Medicine  
For primary bibliographic entry see Fld. 1B.  
HS-012 850

#### **DOCTORS, SAMARITANS AND THE ACCIDENT VICTIM**

York Univ. (Canada)  
For primary bibliographic entry see Fld. 4A.  
HS-012 863

#### **THE RESUSCITATION OF THE MULTIPLE INJURED TRAFFIC VICTIM**

Emergency Associates (Canada)  
L. E. Dagnone  
In HS-012 850

\*Emergency medical services, \*Ambulances, \*Resuscitation, \*First aid, \*Accident survivability, \*Time factors, \*Ambulance personnel training, \*Urban areas, \*Rural areas, \*Kingston (Canada), \*Transportation of injured,

In the Kingston, Ontario area between July and December 1971, the response of ambulance services to 369 emergency calls involving motor vehicle accidents was studied. The time elapsed before the injured reached a treatment center, the type of first aid given at the accident scene and in the ambulance, and changes in the status of the injured during transport were determined. There was a significant time lapse between the notification of a traffic accident and treatment in a hospital's emergency room. In rural areas where 48% of the calls originated, the time elapsed was accentuated, averaging 52 minutes as opposed to 24 minutes in urban areas. During transport the condition of 24 patients improved, 328 remained unchanged, 14 deteriorated, and in two patients there was a loss of vital signs. The need to train ambulance personnel to perform basic resuscitative procedures is emphasized.  
HS-012 873

#### **DEVELOPMENT OF AN EMERGENCY MEDICAL PLAN FOR THE STATE OF NORTH CAROLINA**

Research Triangle Inst.  
S. Trustman  
Sponsored by the Governor's Hwy. Safety Program of the State of North Carolina.  
In HS-012 850

\*Emergency medical services, \*North Carolina, \*Surveys, \*Ambulances, \*Hospital emergency rooms, \*Ambulance personnel training, \*Queueing models, \*Time factors,

A statewide analysis of the current status of North Carolina's emergency medical services and future requirements for such services was initiated in April, 1972. Assistance is being provided to the State of North Carolina in setting up a well-planned emergency medical system.

needs of the people of the State and to Federal guidelines. The study includes a comprehensive survey of existing emergency ambulance services in North Carolina, projecting demand five years into the future, and developing a comprehensive plan for meeting emergency medical service needs. Motor vehicle accidents represent a primary source of demand, but other types of emergency needs are included. The survey data are processed so that the resulting file can form the basis of a management information system in the future.  
HS-012 874

#### **E. M. T.--THE NEW MAN IN OUR TOWN**

Yale Univ.  
W. H. FrazierP. P. LallyT. J. Krizek  
In HS-012 850

\*Ambulance personnel training, \*Emergency medical services, \*Ambulance personnel, \*Curricula, \*Instruction materials,

To improve the quality of emergency medical services, an emergency medical technician (EMT) course was developed for ambulance personnel by the surgical staff at the Yale-New Haven Medical Center. Administration of the program, course participants, and the course curriculum are briefly discussed. Using the American College of Surgeons curriculum, 131 ambulance attendants have completed the course. To determine if there has been an objective change in the level of emergency care as a result of the course, a study of ambulance cases comparing care delivered by EMT's versus non-EMT's has been started. Preliminary results show that in terms of quality of care delivered, two EMT's as a driver-attendant combination are superior to one EMT and one non-EMT, and the latter are superior to two non-EMT's.  
HS-012 875

#### **MILITARY ASSISTANCE TO SAFETY AND TRAFFIC (MAST)**

Army Aeromedical Res. Unit  
W. P. Schane  
In HS-012 850

\*Emergency medical services, \*Helicopter ambulances, \*Military vehicles, \*Transportation of injured, \*Rural areas, \*Medical emergencies,

Military Assistance to Safety and Traffic (MAST) is a cooperative effort of the Transportation, Defense, and Health, Education and Welfare departments to provide military helicopters and paramedical personnel in selected rural and remote areas to augment civilian emergency medical service capabilities where conventional ground transportation is not readily available. MAST programs, begun in 1970, operate out of Fort Sam Houston, Texas; Fort Lewis, Washington; Fort Carson, Colorado; Luke Air Force Base, Arizona; and Mountain Home Air Force Base, Idaho. As of September 1972, a total of 1,340 missions have been flown; 1,642 patients transported; and 2,837.8 flying hours accumulated by the five MAST programs. Criteria for the establishment and operation of MAST are outlined. Advantages and disadvantages of helicopter ambulances are discussed.

## Group 1A—Emergency Services

EMERGENCY VEHICLE ACCIDENT INVOLVEMENT  
1969-1970

New York State Dept. of Motor Vehicles  
F. D. NewcombK. Carpenter  
Corporate author

\*Emergency vehicle accidents, \*Ambulances, \*Fire fighting, \*Police vehicles, \*Accident statistics New York (State), \*Driver age, \*Driver records, \*Male drivers, \*Failure caused accidents, \*Defects, \*Accident costs, \*Life value, \*Accident analysis, \*Intersection collisions, \*Driver error caused accidents, \*Audio warning devices, \*Benefit cost analysis, \*Vehicle inspection, \*Accident prevention,

Accident data for New York State indicate that emergency vehicles are two and one-half times more vulnerable to vehicles entering from a cross street, than non-emergency vehicles. All emergency vehicle drivers are male, and those involved in accidents are over represented in the 25-39 age groups and have 3.2 more accidents on the average than other male drivers. Emergency vehicle drivers cause fewer accidents while operating emergency vehicles than standard vehicle operators cause while operating standard vehicles. Emergency vehicle defects, while a small problem, were disproportionate to vehicle defects occurring in ordinary vehicles, occurring 50% to 500% more frequently. Losses from ambulance accidents are \$1.3 million per year, and fire truck accident losses are \$0.7 million per year. If 30 or more lives are saved per year by ambulance emergency vehicle status, society realized a net gain, based on National Safety Council loss for each life, of \$45,000.

HS-012 890

## 1B. Injuries

AMERICAN ASSOCIATION FOR AUTOMOTIVE MEDICINE CONFERENCE (16th) PROCEEDINGS,  
CHAPEL HILL, NORTH CAROLINA, OCTOBER 19-  
21, 1972

American Assoc. for Automotive Medicine

Sponsored by North Carolina Univ. Hwy. Safety Res. Center, Duke Univ., and Bowman-Gray School of Medicine.  
Corporate author

\*Injury prevention, \*Injury research, \*Accident studies, \*Emergency medical services, \*Occupant protection, \*Air bag restraint systems, \*Restraint system usage, \*Alcohol effects, \*Drugs effects, \*Driver behavior, \*Fatalities, \*Accident research, \*Conferences, \*Drinking drivers, \*Medical factors, \*Forensic medicine, \*Impact attenuators, \*Pedestrian accidents, \*Visual acuity, \*North Carolina,

Topics covered at the conference included emergency medical services, injury research, accident causation, occupant protection, the role of alcohol and drugs in accidents, biomedical monitoring of drivers, and driver behavior.

HS-012 850

CLINICAL EVALUATION OF INJURIES RELATED  
TO SNOWMOBILES

L. J. Sell  
Sponsored by Arctic Enterprises.  
In HS-012 850

\*Snowmobile caused injuries, \*Snowmobile accidents, \*Accident research, \*Injury research, \*Injuries by body area, \*Injury rates, \*Michigan, \*Minnesota, \*Injuries by age, \*Injuries by sex, \*Fatality rates, \*Injury prevention, \*Snowmobile design, \*Time of accidents, \*Leg injuries, \*Drinking drivers, \*Engine size, \*Day of week,

Research related to 224 cases studied in the states of Minnesota and Michigan indicate the primary area of the body involved in snowmobile injuries was the lower leg. The second most frequent area involved was the face and neck. The average individual involved in a snowmobile accident was a 27 year old male operating a machine in the evening hours between 6 p.m. and 10 p.m. The relationship of alcohol, engine size, snowmobile design, clothing used, and weather conditions to the nature of injuries and their severity was considered. Previously published risk of low back compression fracture was not documented by this study. It was also found that injuries to snowmobile operators related to only one anatomical region, unlike the multiple injuries typical of automobile accident victims.

HS-012 852

## MOTOR VEHICLE ACCIDENTS AND BURNS: AN EPIDEMIOLOGIC STUDY OF MOTOR VEHICLE FIRES AND THEIR VICTIMS

Texas Univ.  
Jr., B. G. KingS. AbstonE. B. Evans  
In HS-012 850

\*Burns, \*Vehicle fires, \*Etiology, \*Fire prevention, \*Injury prevention, \*Injury severity, \*Fire extinguishers, \*Galveston, \*Multiple injuries, \*Medical treatment, \*Hospital records, \*Accident caused fires,

This epidemiologic study surveys the records of the Galveston Shriners Burns Institute for Children from 1966 to 1972. During this period 1,267 patients were treated in the acute and reconstructive wards. Thirty-eight burns occurred in motor vehicles. Fractures, respiratory burns, burns to the face and hands, exposure to toxic gases, asphyxia, and death of fellow occupants are all complications seen in motor vehicle accident victims which increase problems of medical management. Details of the complications in both moving and nonmoving accidents are examined and compared to the average burn population. Study of etiologic factors of the burn itself is made. Recommendations are made for acute care, increased federal flammability standards, and possible methods of prevention. Mandatory outfitting of all motor vehicles with dry chemical fire extinguishers is suggested as a method of decreasing vehicle fire injuries and fatalities.

HS-012 854

## EXISTING TRAFFIC ACCIDENT INJURY CAUSATION DATA RECORDING METHODS AND THE PROPOSAL OF AN OCCUPANT INJURY CLASSIFICATION SCHEME

Michigan Univ  
For primary bibliographic entry see Fld. 4.E.  
HS-012 855

## ANALYSIS OF ROLLOVER ACCIDENT FACTORS AND INJURY CAUSATION

Michigan Univ.  
For primary bibliographic entry see Fld. 1.C.  
HS-012 856

## HUMAN TOLERANCE DATA FROM REAL LIFE MOTOR VEHICLE ACCIDENTS

Stanford Univ.

D. A. NagelJ. ManningC. H. ChadwickR. H. CroninR. A. Gould  
Supported in part by the National Hwy. Traffic Safety Adminis-  
tration  
In HS-012 850

\*Human body impact tolerances, \*Human acceleration tolerances, \*Accident analysis, \*Impact velocity, \*Crush distance, \*Least squares method, \*Deceleration, \*Acceleration, \*Impact forces, \*Mathematical analysis, \*Dynamics, \*Multidisciplinary teams, \*Speed changes, \*Occupant kinetics,

The efforts of the Stanford Crash Analysis Team in developing human tolerance data from the investigation of vehicle accidents are discussed. Using data from a small number of accidents, it was found that crush in inches equals 1.13 times velocity change in mph minus 0.5. An examination was made of the possible relationship between the Abbreviated Injury Scale and the Collision Deformation Classification for passenger vehicles and pickup trucks involved in accidents. Findings indicate that the Abbreviated Injury Scale correlates better with change in velocity than with the Collision Deformation Classification. In the course of analyzing 36 accidents, Stanford Crash Analysis Team investigators have developed procedures for applying the laws of dynamics to accident reconstruction. The Procedures for Calculating Average Accelerations in Head On and Rear End Collisions and the Procedures for Calculation for Rear End Collision with Elastic Rebound are mentioned, and the Procedure for Calculating Average Accelerations of Unrestrained Vehicle Occupants is presented in detail.

HS-012 861

## ON THE INFLUENCE OF CRASH HELMETS ON WHIPLASH INJURY TO RACING CAR DRIVERS

Illinois Univ.

L. D. MetzR. L. Ruhl  
In HS-012 850

\*Whiplash injuries, \*Mathematical models, \*Simulation models, \*Acceleration response, \*Racing driver protection, \*Equations of motion, \*Injury causes, \*Injury research, \*Helmets, \*Flexion, \*Extension, \*Torque, \*Head movement, \*Angular acceleration, \*Rotation, \*Inertial forces,

Most racing organizations require drivers to wear crash helmets. The added weight and inertia of such helmets can, under certain conditions, contribute to injury rather than reduce it. A simulation approach to the evaluation of additional injuries which may exist in rear end collisions is discussed and a mathematical model of whiplash injury is presented. It is shown that larger angles of relative head-to-torso rotation are experienced by drivers wearing crash helmets than by unhelmeted drivers under the conditions of the simulation. However, the angular differences between each helmet type and unhelmeted drivers are only on the order of 10 degrees. This is due to the bottoming out of the model segments; in this condition a small increase in angle yields a relatively large increase in resisting torque. The bottom-out stiffness values presented are probably high. This would tend to reduce the amount of relative angular rotation. The simulation model used has been validated by other work.

HS-012 862

## 1C. Investigation And Records

### CLINICAL EVALUATION OF INJURIES RELATED TO SNOWMOBILES

For primary bibliographic entry see Fld. 1B.  
HS-012 852

### SHORT TERM BENEFITS FROM FIELD ACCIDENT STUDIES

National Hwy. Traf. Safety Administration  
E. E. FlamboeS. N. Lee  
In HS-012 850

\*Accident prevention, \*Accident investigation, \*Multidisciplinary teams, \*Accident case reports, \*Highway improvements, \*Accident studies, \*Defective vehicles, \*School bus accidents, \*School bus design, \*Injury severity, \*Injuries by body area, \*Ejection, \*Roadside hazards, \*Truck accidents,

The Field Accident Studies system developed by the National Highway Traffic Safety Administration has been changing from general multidisciplinary accident investigation projects to mission oriented multilevel, bilevel, and special studies. Two general categories of findings have been derived from these accident investigation projects. First are those findings which evaluate, measure, or describe a phenomenon which requires further study to statistically validate its significance. The second set of findings are those which provide a basis for some decisive actions to be taken based on a single occurrence or a small number of occurrences. Specific examples of highway improvements, policy changes, and vehicle improvements, instituted as a result of accident investigation activities, are briefly presented. The Monarch Pass school bus accident is discussed in more detail to illustrate the interagency cooperation and multi-agency use of in-depth accident data collected in the Field Accident Studies.

HS-012 853

### ANALYSIS OF ROLLOVER ACCIDENT FACTORS AND INJURY CAUSATION

Michigan Univ.  
D. F. Huelke4th, J. C. MarshH. W. Sherman  
In HS-012 850

\*Rollover accidents, \*Accident analysis, \*Injury causes, \*Ejection, \*Roof failures, \*Injury severity, \*Crush distance, \*Accident factors, \*Door system failures, \*Fatality rates, \*Injury rates, \*Crushing, \*Accident statistics, \*Injury factors,

One of the most violent automobile accidents in terms of occupant injury exposure is the rollover crash. In this environment the most consistently noted damaged area of the vehicle has been roof crush. It has been hypothesized that the prevention of significant roof crush will result in reduced injury severity. An analysis was made of 249 rollover accident investigation reports. The results disclosed that average occupant injuries in rollovers are at the lower end of the injury severity scale and are similar in severity to injuries in all other types of crashes. However, twice as many fatal injuries occur in rollovers than in all accidents and two-thirds of these fatalities are due to unrestrained occupant ejection. From these data it would appear that containment of occupants within the vehicle would provide

## Group 1C—Investigation And Records

a significant reduction of injury severity levels, and that reducing roof crush in rollover accidents will be of little significance in injury severity reduction.

HS-012 856

### SPECIAL ACCIDENT INVESTIGATION STUDIES: THE ROLE OF ALCOHOL/DRUG INVOLVEMENT

Boston )Sterling-Smith  
R. Sterline-Smith/J. C. Fell  
In HS-012 850

\*Accident investigation, \*Accident studies, \*Drinking drivers, \*Boston, \*Accident causes, \*Human factors, \*Alcohol Safety Action Projects, \*Multidisciplinary teams, \*Accident responsibility, \*Driver records, \*Driver behavior, \*Fatalities, \*Driver characteristics, \*Alcohol usage, \*Drug usage, \*Marijuana, \*Albuquerque, \*Baltimore, \*Driver personality, \*Driver physical fitness, \*Risk taking.

The NHTSA is sponsoring special accident investigation studies on the alcohol/drug involvement problem in the cities of Albuquerque, Baltimore, and Boston. These studies are in coordination with ongoing Alcohol Safety Action Projects (ASAP) in each of the three cities. The first year's effort at Boston is described. A total of 50 accidents involving a fatality during an 8-month period in the Boston ASAP area were investigated. A Human Factors Index (HFI) was determined via interviews, records, and questionnaires on each driver designated to be at fault in the accident. A hypothetical modal operator is described based upon the entire sample. Results discussed include: 42% of the focal operators were under the influence of alcohol at the time of the crash; 60% of the focal operators indicated chronic risk taking behaviors; 62% of the alcohol involved operators were considered to be problem drinkers. A proposed two year continuation of the study is described.

HS-012 858

### DRIVERS INVOLVED IN FATAL PEDESTRIAN COLLISIONS

Johns Hopkins Univ.  
For primary bibliographic entry see Fld. 3D.  
HS-012 859

### INVESTIGATION REPORT OF THE FIRST AIR-BAG DEPLOYMENT IN A REAL-WORLD ACCIDENT

Ford Motor Co.  
C. D. Yost  
In HS-012 850

\*Vehicle vehicle collisions, \*Accident case reports, \*Air bag restraint systems, \*Accident investigation, \*Driver injuries, \*Seat belt effectiveness, \*Ford Mercury,

A 1972 Mercury equipped with an experimental air bag lap belt restraint system collided with a garbage truck at an intersection in Santa Barbara, California, triggering the first air bag deployment in a real-world accident. The lap belted Mercury driver received minor injuries. However, the occupant protection potential of the experimental air-bag was not tested since the bag covered only the right front occupant and that seat was unoccupied. The air bag module is located low in the instrument panel, in the area ordinarily occupied by the glove compartment.

restraint by cushioning the forward motion of the right front occupant if the car becomes involved in a frontal collision of sufficient severity.

HS-012 860

### ROAD ACCIDENTS IN DARKNESS

Transport and Road Res. Lab. (England)  
For primary bibliographic entry see Fld. 1E.  
HS-012 881

### EVALUATION OF REAR-END COLLISION DATA FOR DETERMINING VEHICLE REAR-LIGHTING AND SIGNALING PRIORITIES

For primary bibliographic entry see Fld. 5J.  
HS-012 885

### MOTOR CARRIER ACCIDENT INVESTIGATION. GORDON TRANSPORTS, INC. ACCIDENT--MARCH 16, 1972--BROOKLYN, OHIO

Bureau of Motor Carrier Safety  
72-3  
Corporate author

\*Accident investigation, \*Accident case reports, \*Truck accidents, \*Wheel loss, \*Failure caused accidents, \*Wheel failures, \*Vehicle inspection, \*Preventive maintenance, \*Accident responsibility, \*Truck defects, \*Ohio, \*Tractor semitrailers, \*Driver characteristics,

This accident case report gives details of an accident in which the right front outside dual wheel detached from a tractor semitrailer and crushed the windshield and roof of a car traveling in the opposite direction, killing the driver of the car instantly. The accident was caused by improper installation of the right front outer dual wheel on the semitrailer. The collision was preventable and was caused by the failure of the carrier's management to inspect the wheel repairs (studs and nuts) to determine if the wheel was properly repaired prior to dispatch on the highway.

HS-012 887

### HIGHWAY ACCIDENT REPORT--BUS/STATION WAGON COLLISION, FOLLOWED BY BUS OVERTURN, U.S. ROUTE 66, NEAR MARSHFIELD, MISSOURI, OCTOBER 10, 1971

National Transp. Safety Board  
NTSB-HAR-73-1; SS-R  
Corporate author

\*Accident case reports, \*Accident analysis, \*Vehicle vehicle collisions, \*Driver error caused accidents, \*Wheel locking caused accidents, \*Driver reaction distance, \*Bus accidents, \*Station wagons, \*Rollover accidents, \*Ran off road accidents, \*Ejection, \*Fatality causes, \*Injury causes, \*Accident location, \*Missouri, \*Deformation analysis, \*Injury severity, \*Precrash phase, \*Crash phase, \*Postcrash phase, \*Crashworthiness, \*Attention lapses, \*Driver emergency responses, \*Driver intoxication,

At 2:05 a.m. a westbound bus collided with a station wagon which was attempting to turn around in the westbound lane of

ward by the impact; both its occupants were ejected and the passenger was killed. The bus skidded off the north of the Highway, encountered a drainage ditch, spun clockwise, and overturned. All 38 occupants were injured, four of them fatally, including one of five passengers ejected. The crash was caused by the maneuvering of the station wagon by an intoxicated driver and the bus driver's delayed evasive action. The bus rollover was caused by the lockup of the bus brakes which prevented steering control after the initial crash. Causes of injuries and fatalities to bus occupants were: localized window column failure; absence of passenger restraints; ejections through windows; and unyielding interior bus components. Failure to wear seatbelts contributed to the station wagon occupants' injuries.

HS-012 888

#### SPECIAL STUDY—REDUCED-VISIBILITY (FOG) ACCIDENTS ON LIMITED-ACCESS HIGHWAYS

National Transp. Safety Board  
NTSB-HSS-72-4  
Corporate author

\*Accident investigation, \*Weather caused accidents, \*Fog, \*Reduced visibility caused accidents, \*Controlled access highways, \*Accident prevention, \*Driver education, \*Fog dispersal, \*Fog lamps, \*Highway lighting in fog, \*Fog warning systems, \*Vehicle lighting, \*Traffic law enforcement, \*Speed limits, \*Injury prevention, \*Brake performance, \*Braking distance, \*Benefit cost analysis, \*Driver error caused accidents, \*Driver performance, \*Highway safety standards, \*Emergency medical services, \*Police traffic services, \*Debris removal,

Several accidents in which the presence of fog was a contributing factor were investigated. The approaches that have been taken to prevent fog accidents or that have a bearing on the problem, namely, driver education, fog detection and guidance systems, environmental control, highway department procedures, vehicle and highway lighting, enforcement, and postaccidental control are reviewed. The significance of driver error in fog accidents is discussed. Recommendations intended to alleviate the problem, including driver education, police-highway department procedures for closing highways, enforcement of the basic speed rule as related to fog accidents, mutual-assistance pacts for postaccident control of accidents, and implementation of Highway Safety Programs Standards and Federal Highway Administration plans to develop highway guidance systems are included.

HS-012 889

#### EMERGENCY VEHICLE ACCIDENT INVOLVEMENT 1969-1970

New York State Dept. of Motor Vehicles  
For primary bibliographic entry see Fld. 1A.  
HS-012 890

#### MATHEMATICAL RECONSTRUCTION OF HIGHWAY ACCIDENTS. INTERIM TECHNICAL REPORT

Calspan Corp.  
R. R. McHenry D. J. Segal J. P. Lynch 3rd., P. M. Henderson ZM-  
5096-V-1  
Report for 16 Jan 1972-16 Jan 1973.  
NTIS

\*Accident reconstruction, \*Accident investigation, \*Computer programs, \*Computerized simulation, \*Electronic accident analysis, \*Data processing, \*Simulation models, \*Crash response forecasting, \*Accident simulation, \*Accident diagrams, \*Data acquisition, \*Vehicle trajectories, \*Impact tests, \*Damage severity index, \*Field tests, \*Measuring instruments, \*Radio communication,

A computer program and an associated optical measurement system have been developed to aid the investigation of highway accidents. They are aimed at providing a capability of processing and evaluating scene data, via radio contact with a remote computer, while the investigators are at the accident scene. Results of the second year of effort are presented and discussed. They include detailed comparisons of responses and damage predicted by the developed analytical procedure with corresponding measurements from staged collisions. Field trial results with the optical measurement system are presented. It is concluded that the feasibility of the overall system concept has been established. Remaining difficulties with hardware, that are primarily associated with the communications link, are discussed.

HS-800 801

#### 2. HIGHWAY SAFETY

##### 2D. Design And Construction

#### RECENT DEVELOPMENTS IN ROADSIDE CRASH CUSHIONS: SYNOPSIS

Federal Hwy. Administration  
J. G. Viner  
Complete article published in Transportation Engineering Journal 1968 nTEI, p71-87 (Feb 1972).  
In HS-012 850

\*Impact attenuators, \*Design standards, \*Energy Absorbing barriers, \*Safety device effectiveness, \*Injury prevention,

The design criteria used by the Federal Highway Administration in developing and evaluating roadside impact attenuators are as follows: vehicle weight range, 2,000 to 4,500 pounds; vehicle speed, 60 mph; impact angle, up to 25 degrees as measured from the direction of the roadway; average permissible vehicle deceleration, 12 g's maximum while preventing impacting or penetration of the roadside hazard; and maximum occupant deceleration onset rate, 500 g's per second. These design criteria are intended to result in installations at which high speed accidents would be survivable for the majority of collisions. Data on 283 accidents involving roadside impact attenuators are presented. Examination of the data indicates that, had the attenuator not been present, hospitalizing injuries or fatalities would have been expected in 57 accidents. Only nine hospitalizing injury accidents and four fatal injury accidents occurred in these 57 cases.

HS-012 872

#### MANUAL FOR THE CONSTRUCTION AND MAINTENANCE OF SKID SURFACES. FINAL REPORT

Texas A and M Univ.  
S. C. Britton B. M. Gallaway 794-4  
HS-800 814

**Group 2D—Design And Construction****2G. Meteorological Conditions****THE QUIET REVOLUTION**

V148 N6  
ED., J. M. Callahan  
See serial citation

\*Noise standards, \*Federal laws, \*Noise control, \*Tire noise, \*Sound intensity, \*Noise sources, \*State laws, \*California,

Noise laws traditionally have been directed at both vehicle manufacturers and vehicle users. The Federal Noise Control Act of 1972 sets no standards, calling instead for a procedure leading to the control of all noise. This act must tell its regulatees how to attenuate or reduce any objectionable noises. Manufacturers' difficulties in meeting California's stringent noise control standards and federal standards for 1975 are outlined. Tires, which are the major source of automobile noise, and other noise sources are discussed. A major problem is lack of information on vehicle noise among non-professionals and the public.

HS-012 884

**2H. Police Traffic Services****CHP FINDS KEY TO CUTTING...THE DRUNK DEATH TOLL**

For primary bibliographic entry see Fld. 3A.  
HS-012 895

**POLICE TRAFFIC SERVICES INSTRUCTOR TRAINING INSTITUTE. FINAL REPORT**

Dunlap and Associates, Inc.  
A. Cleven  
Report for 20 Jun-20 Dec 1972.  
NTIS

\*Instructor training, \*Police traffic services, \*Curricula, \*Instruction materials, \*Visual aids, \*Police training,

Five 30-hour instructor training institutes were conducted in the fall of 1972. Sixty-six enrollees from 39 different states plus Puerto Rico and the District of Columbia completed the training program. Most enrollees are associated with statewide ongoing programs. The enrollees responded favorably to the institute and 92% reported that they intended to use all or some of the NHTSA curriculum materials for their future police traffic services training. Institute and lesson outlines and forms are included.

HS-000 794

**DEVELOPMENTAL METHODOLOGY: BASIC TRAINING PROGRAM FOR POLICE TRAFFIC SERVICES. FINAL REPORT**

Dunlap and Associates, Inc.  
A. HaleJ. W. Hamilton  
Report for 21 Jun 1971-21 Oct 1972.  
GPO

\*Police training, \*Police traffic services, \*Curricula, \*Traffic laws, \*Traffic law enforcement, \*Traffic courts, \*Police motorist contacts, \*Accident investigation, \*Traffic control,

A functional task analysis of the job entitled patrolman or police officer provided the outline of a 103 hour in-service course. Lesson units of the curriculum are grouped by the following functions: traffic law, traffic direction and control, traffic law enforcement, accident site management, traffic court, and services for motorists. The course materials developed have been published in the form of a course guide, instructor's lesson plans, and student study guide. A description of the pilot testing of the course materials is included, along with a complete list of references used in the development of the course.

HS-800 822

**POLICE TRAFFIC SERVICES SUPERVISORY LEVEL TRAINING. FINAL REPORT**

Dunlap and Associates, Inc.  
E. W. Bishop  
Report for 21 Jun 1971-21 Oct 1972.  
GPO

\*Police training, \*Police supervision, \*Police traffic services, \*Instruction materials, \*Curricula, \*Data acquisition, \*Manpower utilization,

The research for and development of instructional materials for police supervisors with traffic responsibilities is described. A functional definition of police traffic services supervision was developed. It was assumed that the course would be aimed at the supervisor of traffic patrolmen. A tabulation and summary of the skills and knowledge required for each activity encompassed by this functional definition is included. The summary was used to develop training objectives which formed the basis for the development of a course outline. This outline and course planning considerations are included.

HS-800 823

**2J. Traffic Courts****CHP FINDS KEY TO CUTTING...THE DRUNK DEATH TOLL**

For primary bibliographic entry see Fld. 3A.  
HS-012 895

**IMPROVED DISPOSITION OF TRAFFIC CASES. SUMMARY VOLUME. FINAL REPORT**

Indiana Univ.  
HS-034-1-178-72-4  
Report for 25 Jun 1971-31 Aug 1972.  
NTIS

For abstract and search terms, see HS-800 820 and HS-800 821.  
HS-800 819

**IMPROVED DISPOSITION OF TRAFFIC CASES. REFERENCE VOL. 1, LITERATURE SURVEY, MAIL SURVEY, STATUTE SURVEY, AND STATUTE FUNCTION CROSS-TABULATIONS REPORT. FINAL REPORT**

Indiana Univ.  
HS-034-1-178-72-3-Vo  
Report for Jun 25, 1971 - Aug 31, 1972. Summary report is HS-800 819.  
NTIS

\*Traffic law enforcement, \*Traffic law violations, \*Traffic courts, \*Driver prosecution, \*Reviews, \*State laws, \*Legal factors, \*Surveys, \*Traffic ticket systems, \*Arrest procedures, \*Questionnaires, \*Flow charts,

The study examined current practices within the United States for the processing of traffic cases in order to identify promising new approaches for improving the disposition of traffic cases. In this volume a survey of literature describing and analyzing traffic case disposition systems; the results of a national mail survey conducted to identify innovative methods or practices in handling traffic cases; and the results of a comprehensive survey of applicable statutes in all fifty states and the District of Columbia are presented.

HS-800 820

### **IMPROVED DISPOSITION OF TRAFFIC CASES. REFERENCE VOL. 2, ADMINISTRATIVE ADJUDICATION OF TRAFFIC CASES IN NEW YORK CITY. FINAL REPORT**

Indiana Univ.

HS-034-1-178-72-3-Vo

Report for Jun 25, 1971 - Aug 31, 1972. Summary report is HS-800 819.

NTIS

\*Traffic law enforcement, \*Traffic courts, \*New York (City), \*Systems analysis, \*Traffic law violations, \*Information systems, \*Opinion polls, \*Public opinion, \*Legal factors, \*Flow charts, \*Driver prosecution, \*Traffic ticket systems, \*Computerized records management, \*State motor vehicle departments, \*Data processing, \*Questionnaires,

The results of in-depth case study of the administrative traffic case adjudication system now operating in New York City (NYCAAS) are presented. The study describes the legal and societal environment of the system, the system's functions and procedures, and presents the results of a preliminary survey of the attitudes of the general population and of those who had been defendants in hearings conducted by the NYCAAS. The primary distinctions of the NYCAAS are as follows: the multi-page traffic ticket form is clear and simple to use; provision is made for guilty with explanation pleas; the scheduling of hearings and police officer appearances minimizes wasted resources; innovative and relatively effective techniques have been developed to deal with scofflaws; one system manager has the authority to control and manage the entire system except for the law enforcement function; and the NYCAAS information system provides system personnel with needed information precisely when it is needed.

HS-800 821

### **TWO EXPERIMENTAL STUDIES OF TRAFFIC LAW. VOL 1, THE EFFECT OF LEGAL SANCTIONS ON DUI OFFENDERS. FINAL REPORT**

GEOMET, Inc.

M. Blumenthal H. L. Ross MF-203

Prepared in cooperation with Denver Univ. Report for Jun 1972 - Feb 1973.

NTIS

\*Driver intoxication, \*Courts, \*Driver records, \*Penalties, \*Denver, \*Legal factors, \*Convictions, \*Driver rehabilitation, \*Chi square test, \*Age factors, \*Sex factors, \*Racial factors,

\*Drinking drivers, \*Degrees of freedom, \*Program evaluation, \*Data processing,

Denver County Court judges agreed to assign penalties of a fine, conventional probation, or rehabilitative probation according to a fixed schedule to 495 drivers convicted of a first offense of driving while intoxicated. Judges' frequent departures from the schedule made it necessary to introduce statistical controls in comparisons of subsequent records. In neither the original treatment groups nor the groups created by the judges' actual sentences were there any significant differences in subsequent driver records. Those drivers sentenced to jail rather than to one of the three prescribed treatments also did not differ from the balance of the group in subsequent records. Representation by a lawyer is powerfully effective in obtaining a more favorable legal treatment for defendants accused of driving while intoxicated. Defendants with reduced charges had poorer subsequent records. Those receiving unscheduled sanctions showed no benefit in terms of subsequent records from the research plan.

HS-800 825

### **TWO EXPERIMENTAL STUDIES OF TRAFFIC LAW, VOL. 2: THE EFFECT OF COURT APPEARANCE ON TRAFFIC HS-800 826**

### **3. HUMAN FACTORS**

#### **3A. Alcohol**

### **AN INVESTIGATION OF SERIAL CHOICE REACTION TIME AS THE BASIS FOR AN ALCOHOL INTERLOCK**

Ohio State Univ.

For primary bibliographic entry see Fld. 3D.  
HS-012 849

### **SPECIAL ACCIDENT INVESTIGATION STUDIES: THE ROLE OF ALCOHOL/DRUG INVOLVEMENT Boston/Sterling-Smith For primary bibliographic entry see Fld. 1C. HS-012 858**

### **THE EFFECTS OF CERTAIN TRANQUILIZERS AND ALCOHOL UPON KINETIC VISUAL ACUITY Birmingham Univ. (England) For primary bibliographic entry see Fld. 3L. HS-012 864**

### **SEMANTIC GYMNASTICS IN ALCOHOL-HIGHWAY CRASH RESEARCH AND PUBLIC INFORMATION PROGRAMS**

Rutgers--The State Univ.

R. Zylman  
In HS-012 850

\*Semantics, \*Drinking drivers, \*Accident research, \*Public information programs, \*Alcohol usage deterrents, \*Driver intoxication, \*Alcoholism, \*Accident statistics, \*Fatalities, \*Alcohol usage, \*Highway safety literature effectiveness, \*Research dissemination, \*Blood alcohol levels, \*High risk drivers, \*Academic responsibility,

frequently misinterpreted, misapplied, misquoted, ignored, or not read. As a result, exaggerated numbers of traffic deaths are attributed to alcohol; alcoholics are blamed for more than their share of fatal crashes; and the number of drunken drivers on the road have been inflated. Such terms as has been drinking or related to alcohol are misleading. The lack of knowledge as to what constitutes either safe or illegal blood alcohol levels in relation to one's own drinking is widespread. The single most important countermeasure that can be applied is a reexamination of available reliable data. There is a need for an interdisciplinary agency or center to gather, evaluate, and assimilate research reports and to disseminate useful information.

HS-012 867

#### A CRITICAL EVALUATION OF THE PHYSTERE: A TEST FOR DRIVER IMPAIRMENT

General Motors Corp.  
T. O. Jones J. A. Tennant  
In HS-012 850

\*Alcohol detection and interlock systems, \*Phystester, \*Safety device effectiveness, \*Driver performance, \*Manual performance, \*Blood alcohol levels, \*Alcohol effects, \*Reaction time, \*Driver tests, \*Driver physiological test devices, \*Learning rates, \*Intoxication, \*Motivation, \*Age factors, \*Sex factors, \*Alcohol usage, \*Intelligence, \*Driving simulators, \*Consumer acceptance, \*Benefit cost analysis, \*Histograms, \*Correlation analysis, \*Driver characteristics,

The Phystester is an ignition interlock system based on a predriving performance test. Results and observations from programs evaluating the Phystester are analyzed. The sensitivity of the Phystester's psychomotor task to blood alcohol concentration, performance asymptoticity through distributed training, age, intelligence, drinking habits, sex, and digital dexterity was found to be minimal. Parametric optimization of the task variables and of the test criteria, and correlation of Phystester with driving performance at various blood alcohol levels are discussed. The alcohol test results indicate that while the Phystester with a universal threshold is capable of discriminating between sober and intoxicated individuals, the debilitating effects of alcohol are not large enough to eliminate more than 50% of the drivers at blood alcohol levels of 0.1% without eliminating also a large number of sober drivers. However, a great deal of promise is shown if the individualized threshold approach is taken.

HS-012 869

#### CHP FINDS KEY TO CUTTING...THE DRUNK DEATH TOLL

v37 n1  
W. L. Roper  
See serial citation

\*Driver intoxication, \*Fatality prevention, \*Highway safety programs, \*Police law enforcement responsibilities, \*California, \*Alcohol laws, \*Alcohol Safety Action Projects, \*Public information programs, \*Alcohol education, \*Alcohol usage deterrents, \*Arrests, \*Convictions, \*Traffic courts, \*Alcoholism, \*Drinking drivers, \*Federal aid,

percentage of arrested drinking drivers are convicted. Alcohol Safety Action Projects have been established to deter heavy social drinkers by publicity emphasizing intensified law enforcement, to induce those who think they can drink and drive to control their drinking, and to identify problem drinkers and require them to take curative treatment. The importance of alcohol education is emphasized. Much of the major burden of educating the public falls on State and local law enforcement officials. Federal alcohol taxes should be used to combat the problem of drinking drivers.

HS-012 895

#### TWO EXPERIMENTAL STUDIES OF TRAFFIC LAW. VOL 1, THE EFFECT OF LEGAL SANCTIONS ON DUI OFFENDERS. FINAL REPORT

GEOMET, Inc.  
For primary bibliographic entry see Fld. 2J.  
HS-800 825

#### 3D. Driver Behavior

#### AN INVESTIGATION OF SERIAL CHOICE REACTION TIME AS THE BASIS FOR AN ALCOHOL INTERLOCK

Ohio State Univ.  
E. D. McDowell Jr., G. L. Smith SAE-730090  
Presented at International Automotive Engineering Congress,  
Detroit, 8-12 Jan 1973.  
SAE

\*Alcohol detection and interlock systems, \*Blood alcohol levels, \*Driver intoxication, \*Driver reaction time, \*Performance tests, \*Design of experiments, \*Test volunteers, \*Alcohol breath tests, \*Regression analysis, \*Alcohol effects,

Two measures of driver performance, the total time to complete a serial choice reaction time (SCRT) task plus the number of errors, and the number of response times exceeding 1.1 seconds duration plus the number of errors (PS), were investigated. Both measures increased in proportion to the square of the blood alcohol level (BAL) with the PS measure increasing more rapidly. A sequential criteria task that minimizes task duration (less than seven seconds) is proposed. This task would reject approximately 30% of the subjects at 0.10% BAL while only failing 1% when sober. SCRT tasks show promise as a basis for an ignition interlock, although additional work is necessary.

HS-012 849

#### AMERICAN ASSOCIATION FOR AUTOMOTIVE MEDICINE CONFERENCE (16th) PROCEEDINGS, CHAPEL HILL, NORTH CAROLINA, OCTOBER 19-21, 1972

American Assoc. for Automotive Medicine  
For primary bibliographic entry see Fld. 1B.  
HS-012 850

## STRESS, CRISIS AND LIFESTYLE CHANGES AND TRAFFIC VIOLATIONS AND ACCIDENTS

North Carolina Univ. Hwy. Safety Res. Center  
D. W. JeffreyJ. FoleyP. Waller  
In HS-012 850

\*Driver behavior, \*Driver performance, \*Stress (psychology), \*Traffic law violations, \*Accident rates, \*Accident risks, \*Psychological factors, \*Data analysis, \*Questionnaires, \*Driver records, \*Chi square test, \*Marital status, \*Driver age, \*Driver educational levels, \*Driver social class, \*Driver occupation, \*North Carolina, \*Driver mileage,

Stress factors experienced by drivers with a recent sharp increase in traffic accident or violation involvement were compared with those experienced by a control group. The Stress and Crisis Evaluation Questionnaire was administered by telephone to the stress group and with minor modifications, to a matched control group. Interviewed subjects in both groups showed no significant differences on the basis of age, sex, race, education, or socioeconomic level. A significantly higher percentage in the stress group reported changes or problems in their health during the previous year. The stress group also had a significantly higher proportion of respondents reporting arguments or disagreements with others, recent engagement or planned engagement, or separation from spouse. Health changes or problems in the respondent's family during the previous year and job problems were not significantly higher among the stress group than the control group.

HS-012 857

## SPECIAL ACCIDENT INVESTIGATION STUDIES: THE ROLE OF ALCOHOL/DRUG INVOLVEMENT

Boston )Sterling-Smith  
For primary bibliographic entry see Fld. 1C.  
HS-012 858

## SPECIAL ACCIDENT INVESTIGATION STUDIES: THE ROLE OF ALCOHOL/DRUG INVOLVEMENT

Boston )Sterling-Smith  
For primary bibliographic entry see Fld. 1C.  
HS-012 858

## DRIVERS INVOLVED IN FATAL PEDESTRIAN COLLISIONS

Johns Hopkins Univ.  
S. P. BakerL. S. RobertsonB. O'Neill  
Sponsored by Insurance Inst. for Hwy. Safety and Maryland Medical-Legal Foundation.  
In HS-012 850

\*Driver behavior, \*Accident research, \*Vehicle pedestrian collisions, \*Baltimore, \*Accident responsibility, \*Negligence, \*Driver records, \*Pedestrian fatalities, \*Pedestrian behavior,

negligence was correlated with poor driving records. The study drivers had more points for traffic convictions than the average Maryland driver. Subsequently, 46 drivers (25%) were convicted of traffic violations. For the 22 drivers whose licenses were revoked, the median length of time until revocation was 8 months. Recommendations include chemical tests for alcohol of all drivers who kill pedestrians and swifter suspension of licenses of those drivers believed to pose a substantial hazard to society. Since the behavior of high risk drivers may prove to be as difficult to modify as that of high risk pedestrians, ultimate solutions probably lie in modifying roads, vehicles, and traffic patterns in order to reduce pedestrian injuries and deaths.

HS-012 859

## PULMONARY VENTILATION AND ENERGY EXPENDITURE IN CAR DRIVING WITH AND WITHOUT SEAT BELTS

Fiat S.p.A. (Italy)  
V. Wyss  
In HS-012 850

\*Driving task analysis, \*Energy consumption, \*Respiration, \*Musculoskeletal system, \*Three point restraint systems, \*Balance (physiology), \*Biomedical monitoring, \*Biomechanics, \*Human body kinetics, \*Inertial forces, \*Driver physiological test devices, \*Mountain driving, \*Driving conditions, \*Drivers, \*Passengers, \*Test tracks, \*Speed, \*Muscular forces, \*Road curves, \*Lateral force,

Pulmonary ventilation and energy expenditure were measured on six subjects during driving tests to determine whether three point restraint systems would reduce the muscular work necessary to maintain body balance and permit easier driving. The tests were conducted on a ring course and on a mountain road. The ring course was traveled clockwise in a first group of tests and counterclockwise in the second group. Detailed measurements are presented in tabular form. It was concluded that the use of seat belts reduced both the pulmonary ventilation and the energy expenditure of drivers in the counterclockwise test and of passengers in the clockwise test. A similar saving in energy expenditures was recorded for both drivers and passengers during the uphill and downhill tests on winding roads. Factors, such as vehicle speed, seat belt type, and individual functional characteristics, can have a bearing on results.

HS-012 865

## RECORDING AND ANALYSIS OF PHYSIOLOGICAL RESPONSES AND VEHICLE DATA DURING HIGH SPEED DRIVING

California Univ. Los Angeles  
J. BerkhouitR. D. O'DonnellP. M. HahnR. Bieber  
Prepared in cooperation with the Federal Hwy. Administration.  
In HS-012 850

\*Driver monitoring, \*Biomedical monitoring, \*Instrumented vehicles, \*Driver performance, \*Telemetry, \*Multiplexers,

### **Group 3D—Driver Behavior**

\*Electroencephalography, \*Electrocardiography, \*Eye movements, \*Accelerometers, \*Data transmission, \*Data acquisition, \*Data reduction, \*Vehicle control, \*Heart rate, \*Lateral acceleration,

A 14-channel system was constructed for the simultaneous recording of physiological data with automobile control and motion parameters. The system was installed in a Dodge Polara police cruiser and over 30 hours of data were recorded during high speed driving on the California Highway Patrol emergency vehicle training facility. FM-FM telemetry was used to obtain 4-channel electroencephalogram, 2-channel electrooculogram, and electrocardiogram signals from the drivers. Vehicle sensors indicating throttle position, steering wheel position, brake pedal force, road position, and lateral acceleration levels were simultaneously monitored. FM multiplexing was used to compress the 13 data channels onto two direct record tape cassette tracks and subsequently onto paper charts. Several novel measures of driving performance have been derived from these charts utilizing a contingent scoring of lateral acceleration levels, vehicle control operations, elapsed block times, eye movements, and heart rate.

HS-012 866

#### **A CRITICAL EVALUATION OF THE PHYSTESTER: A TEST FOR DRIVER IMPAIRMENT**

General Motors Corp.

For primary bibliographic entry see Fld. 3A.

HS-012 869

#### **ACCIDENT AND VIOLATION EXPERIENCE OF OKLAHOMA DRIVERS WITH SELECTED CHRONIC MEDICAL CONDITIONS**

East Carolina Univ.

For primary bibliographic entry see Fld. 3F.

HS-012 871

#### **DRIVER IMPROVEMENT TRAINING AND EVALUATION: INITIAL DEVELOPMENT. FINAL REPORT**

American Univ.

For primary bibliographic entry see Fld. 3E.

HS-800 680

#### **TWO EXPERIMENTAL STUDIES OF TRAFFIC LAW, VOL. 2: THE EFFECT OF COURT APPEARANCE ON TRAFFIC**

For primary bibliographic entry see Fld. 2J.

HS-800 826

### **3E. Driver Education**

#### **DRIVER IMPROVEMENT TRAINING AND EVALUATION: INITIAL DEVELOPMENT. FINAL REPORT**

American Univ.

J. A. WhitenburgR. F. PainR. McBrideJ. Amidei

Prepared in cooperation with the Coast Guard.

NTIS

\*Driver education, \*Driver education evaluation, \*Driver evaluation devices, \*Driving task analysis, \*Driving task

models, \*Driver performance, \*Driver tests, \*Driver attitude measurement, \*Driver behavior, \*Driver records, \*Driver characteristics, \*Socioeconomic data, \*Male drivers, \*Perception, \*Decision making, \*Driver mileage, \*Driver experience, \*Correlation analysis, \*Factor analysis, \*Chi square test, \*Questionnaires, \*Interviews. Training facilities, \*Curricula, \*Benefit cost analysis, \*Reviews, \*Driver modeling, \*Data acquisition,

A driver improvement training program using multimedia classroom lessons and multiple car driving range exercises was given to U.S. Coast Guard recruits. Training was evaluated by comparing matched control and experimental groups. Baseline data, including driving history, biographical, and physical characteristics, were collected. Driving range, attitude, and knowledge tests comprised the intermediate criteria tests used for testing. Seven ultimate criterion data sources were identified and data collection instruments developed. A conceptual framework with models of the driving process and human information processing and literature reviews are included. The experimental group and control group test scores were the same at pretest. At posttest the experimental group scored significantly higher than at pretest and higher than the control group. Future plans for data analyses and diagnostic testing and individualized training were started.

HS-800 680

### **3F. Driver Licensing**

#### **COLLECTION, ANALYSIS AND INTERPRETATION OF DATA ON RELATIONSHIP BETWEEN DRUGS AND DRIVING—A STUDY OF DRUG USAGE AND DRIVING HISTORIES AMONG ARRESTEES IN SIX METROPOLITAN AREAS OF THE U.S.**

Research Triangle Inst.

For primary bibliographic entry see Fld. 3G.

HS-012 868

#### **AN ANALYSIS OF THE NORTH CAROLINA DRIVER MEDICAL EVALUATION PROGRAM**

North Carolina Univ. Hwy. Safety Res. Center

E. A. PascarellaJ. N. MacCormackR. L. Dean

In HS-012 850

\*Driver licensing, \*Driver physical fitness, \*Driver records, \*Driver performance, \*Driver license restrictions, \*Accident rates, \*Traffic law violations, \*Program evaluation, \*North Carolina, \*Driver age, \*Medical factors, \*Diseases,

A study of the North Carolina Driver Medical Evaluation Program was undertaken to assess the effects of the program upon objective measures of the driving task. The study group was formed of 4,117 subjects who were medically evaluated and submitted to a system of restraints imposed upon their operation of motor vehicles during the two year period from September 1, 1968 through August 31, 1970. Accidents and selected violations compiled from the official driving record were collected over a year's time in both retrospective and prospective periods relative to the subject's induction into the evaluation process. Driving performance was examined for each class of restriction and from every stage of the medical evaluation process. Comparisons were made within the experimental groups and against a random sample from the general driving

population. The data suggest a consistent measure of improvement in driving performance for medically evaluated subjects.  
HS-012 870

#### **ACCIDENT AND VIOLATION EXPERIENCE OF OKLAHOMA DRIVERS WITH SELECTED CHRONIC MEDICAL CONDITIONS**

East Carolina Univ.  
T. G. DavisE. H. WEHLING  
In HS-012 850

\*Driver records, \*Epilepsy, \*Diabetic drivers, \*Diseases, \*Driver performance, \*Oklahoma, \*Accident rates, \*Traffic law violations, \*Medical factors, \*Male drivers, \*Female drivers, \*Driver physical fitness,

The driving records of 108 diabetics, 77 epileptics, 78 persons with other specified neurological conditions, and 55 persons diagnosed as having a cardiac or circulatory condition, who were granted driver licenses after being evaluated by the Oklahoma Medical Advisory Committee in 1969, were studied. The accident rates of individuals in the selected disease categories were compared to the accident rates of Oklahoma's 1.65 million licensed drivers according to age, sex, and years of driving exposure. The violation rates of the disease groups were compared to the overall violation rate of all licensed Oklahoma drivers. It was determined that epileptics, diabetics, and persons with other neurological conditions have higher accident and violation rates than licensed Oklahoma drivers not known to be affected. Oklahoma drivers diagnosed as suffering from cardiac or circulatory conditions, as a group, have lower violation rates and slightly higher accident rates than drivers not known to be affected.  
HS-012 871

#### **3G. Drugs Other Than Alcohol**

##### **THE EFFECTS OF CERTAIN TRANQUILIZERS AND ALCOHOL UPON KINETIC VISUAL ACUITY**

Birmingham Univ. (England)  
For primary bibliographic entry see Fld. 3L.  
HS-012 864

##### **COLLECTION, ANALYSIS AND INTERPRETATION OF DATA ON RELATIONSHIP BETWEEN DRUGS AND DRIVING—A STUDY OF DRUG USAGE AND DRIVING HISTORIES AMONG ARRESTEES IN SIX METROPOLITAN AREAS OF THE U.S.**

Research Triangle Inst.  
B. A. MoserL. D. BresslerR. B. Williams  
In HS-012 850

\*Driver performance, \*Driver behavior, \*Driver records, \*Drug usage, \*Accident rates, \*Traffic law violators, \*Urinalysis, \*Male drivers, \*Alcohol usage, \*Driver criminal history,

The purpose of this study was to determine if drug usage is related to driving history. Laboratory analyses of urine samples, in-depth interviews, and driving records were obtained to investigate the relationship of traffic accidents and violations between male users and nonusers of alcohol and drugs. Data were collected in six geographical areas. The frequency and

amount of drugs used were analyzed in terms of driving performance for 1,889 arrestees for serious crimes. In general the results show that for this select population, drug using drivers have no worse driving records, in terms of accidents and convictions, than the nondrug using drivers.  
HS-012 868

#### **3H. Environmental Effects**

##### **TOXICITY EVALUATION OF CRASH RESTRAINT GAS GENERATORS**

Rocket Res. Corp.  
For primary bibliographic entry see Fld. 5N.  
HS-012 879

##### **ROAD ACCIDENTS IN DARKNESS**

Transport and Road Res. Lab. (England)  
For primary bibliographic entry see Fld. 1E.  
HS-012 881

##### **SPECIAL STUDY--REDUCED-VISIBILITY (FOG) ACCIDENTS ON LIMITED-ACCESS HIGHWAYS**

National Transp. Safety Board  
For primary bibliographic entry see Fld. 1C.  
HS-012 889

#### **3K. Pedestrians**

##### **DRIVERS INVOLVED IN FATAL PEDESTRIAN COLLISIONS**

Johns Hopkins Univ.  
For primary bibliographic entry see Fld. 3D.  
HS-012 859

#### **3L. Vision**

##### **THE EFFECTS OF CERTAIN TRANQUILIZERS AND ALCOHOL UPON KINETIC VISUAL ACUITY**

Birmingham Univ. (England)  
A. B. ClaytonG. M. MackayT. A. Betts  
In HS-012 850

\*Visual acuity, \*Visual degradation, \*Alcohol effect on vision, \*Drug effects, \*Tranquilizers, \*Vision tests, \*Males, \*Females, \*England, \*Test equipment, \*Variance analysis, \*Sex factors,

Kinetic visual acuity (K.V.A.) is the ability to perceive a moving object travelling towards the eye at a constant speed in a horizontal plane. Using a fully-randomized double-blind procedure, the K.V.A. of four groups of 20 subjects (10 men and 10 women) was tested under the influence of trifluoperazine, chlordiazepoxide, haloperidol, amylobarbitone sodium, and a placebo. Within each treatment, the subjects were also tested with and without alcohol. Trifluoperazine produced a significant impairment in K.V.A. values for male subjects, and for female subjects under alcohol. Amylobarbitone sodium and chlordiazepoxide produced some improvement in K.V.A. values, whereas haloperidol produced different effects in males and females. Alcohol did not produce a significant overall effect upon K.V.A. values. It is suggested that physicians should warn patients of the possible danger in driving during the early stages of treatment.  
HS-012 864

## DOCTORS, SAMARITANS AND THE ACCIDENT VICTIM

York Univ. (Canada)  
R. J. Gray G. S. Sharpe  
In HS-012 850

\*Forensic medicine, \*Good Samaritan laws, \*Legal factors, \*Laws, \*Legal responsibility, \*Court decisions, \*Liability, \*Sociological factors, \*Psychological factors, \*Physicians, \*Questionnaires, \*Surveys, \*France, \*Europe, \*North America, \*First aid,

An examination is made of the problem of the reluctance of physicians and others to stop and render assistance at highway accidents for fear of lawsuits. The North American solution of enacting Good Samaritan Laws which relieve physicians and others of possible civil liability when they do stop to offer their services is reviewed and compared to the European solution. In most European countries laws have been enacted which requires all individuals to stop and assist at accident scenes under penalty of fine and imprisonment for failure to do so. It is recommended that legislation following the European model be enacted in North America in addition to the present Good Samaritan Laws. Survey evidence presented indicates that such legislation would be approved by most physicians.

HS-012 863

## IMPROVED DISPOSITION OF TRAFFIC CASES. REFERENCE VOL. 1, LITERATURE SURVEY, MAIL SURVEY, STATUTE SURVEY, AND STATUTE FUNCTION CROSS-TABULATIONS REPORT. FINAL REPORT

Indiana Univ.  
For primary bibliographic entry see Fld. 2J.  
HS-800 820

## 4B. Community Support

### THE ROLE OF A PROFESSIONAL SOCIETY FOR TRAFFIC MEDICINE

American Assoc. for Automotive Medicine  
R. E. Marland  
Presented at International Congress on Accidents and Traffic Medicine, (4th), Paris, 15 Sep 1972.  
In HS-012 850

\*Professional role, \*Safety organizations, \*Community support, \*Leadership, \*Public opinion,

The two critical functions of a professional society for traffic medicine should include contributions to scientific progress and stimulation of society to change apathy to action. The professional society's role in making the public aware of the research and development in the field of traffic medicine is emphasized.

HS-012 851

## SEMANTIC GYMNASTICS IN ALCOHOL-HIGHWAY CRASH RESEARCH AND PUBLIC INFORMATION PROGRAMS

Rutgers--The State Univ.

## 4C. Cost Effectiveness

### EMERGENCY VEHICLE ACCIDENT INVOLVEMENT 1969-1970

New York State Dept. of Motor Vehicles  
For primary bibliographic entry see Fld. 1A.  
HS-012 890

### EMERGENCY VEHICLE ACCIDENT INVOLVEMENT 1969-1970

New York State Dept. of Motor Vehicles  
For primary bibliographic entry see Fld. 1A.  
HS-012 890

## 4D. Governmental Aspects

### 1972 NATIONAL TRANSPORTATION REPORT. PRESENT STATUS-FUTURE ALTERNATIVES

Department of Transp.  
For primary bibliographic entry see Fld. 4H.  
HS-012 880

## 4E. Information Technology

### EXISTING TRAFFIC ACCIDENT INJURY CAUSATION DATA RECORDING METHODS AND THE PROPOSAL OF AN OCCUPANT INJURY CLASSIFICATION SCHEME

Michigan Univ  
4TH., J. C. Marsh  
In HS-012 850

\*Injury classification, \*Automated accident records, \*Coding systems, \*Injury causes, \*Injury severity index, \*Data processing, \*Injuries by body area, \*Computerized records management,

Injury causation data on 2,500 traffic accident victims has been recorded on the Collision Performance and Injury Report, Long Form, Revision 3, and processed by the Highway Safety Research Institute into time shared computer files for analysis via remote terminals. The current injury causation recording system is described in order to demonstrate the potential for and the problems with analysis of this data. An improved recording system, the Occupant Injury Classification (OIC) scheme, that will facilitate the computer processing of injury causation data is proposed. The OIC follows an approach similar to Collision Deformation Classification, by using four letters to encode Body Region, Aspect, Lesion, and Body System/Organ, followed by the numeric Abbreviated Injury Severity code. The OIC can be used to link specific injuries to their causes or contact areas in an easy and flexible manner.

HS-012 855

### MATHEMATICAL RECONSTRUCTION OF HIGHWAY ACCIDENTS. INTERIM TECHNICAL REPORT

Calspan Corp.  
For primary bibliographic entry see Fld. 1C.  
HS-800 801

Michigan Univ.

For primary bibliographic entry see Fld. 5F.

HS-012 845

## HUMAN TOLERANCE DATA FROM REAL LIFE MOTOR VEHICLE ACCIDENTS

Stanford Univ.

For primary bibliographic entry see Fld. 1B.

HS-012 861

## ON THE INFLUENCE OF CRASH HELMETS ON WHIPLASH INJURY TO RACING CAR DRIVERS

Illinois Univ.

For primary bibliographic entry see Fld. 1B.

HS-012 862

## ANALYSIS OF VARIANCE WITH DICHOTOMOUS DEPENDENT VARIABLES: A TOOL FOR GAINING INSIGHT FROM TRAFFIC ACCIDENT DATA

For primary bibliographic entry see Fld. 1E.

HS-012 882

## TIRE TRACTION RESEARCH

For primary bibliographic entry see Fld. 5V.

HS-012 886

## ANALYSIS AND MEASUREMENT OF THE RELATIVE MOVEMENTS BETWEEN THE ROAD WHEELS OF A VEHICLE AND THE ROAD SURFACE

For primary bibliographic entry see Fld. 5D.

HS-012 897

## A NEW CLASS OF ROTARY PISTON MACHINE SUITABLE FOR COMPRESSORS, PUMPS AND INTERNAL COMBUSTION ENGINES

For primary bibliographic entry see Fld. 5D.

HS-012 898

## ADAPTIVE BRAKE CONTROL SYSTEM

For primary bibliographic entry see Fld. 5A.

HS-012 901

## PREDICTING DIESEL ENGINE PERFORMANCE AT VARIOUS AMBIENT CONDITIONS

International Harvester Co.

For primary bibliographic entry see Fld. 5D.

HS-012 902

## RATING TRACTION AND WEAR--A REVIEW

Cornell Aeronautical Lab, Inc.

For primary bibliographic entry see Fld. 5V.

HS-012 904

## 4H. Transportation Systems

### 1972 NATIONAL TRANSPORTATION REPORT. PRESENT STATUS--FUTURE ALTERNATIVES

Department of Transp.

\*Transportation planning, \*Transportation problems, \*Transportation statistics, \*Transportation of aged, \*Transportation of handicapped, \*Transportation of poor, \*Forecasting, \*Budgets, \*State action, \*Federal role, \*Federal aid, \*Urban transportation, \*Rural transportation,

The purpose of this report is to provide the executive branch and the U. S. Congress with information upon which to base future Federal aid programs in transportation. Guidelines for future action by Federal, State, and local governments and the private sector are presented. A status report of the U. S. transportation system performance operation, finance, and related problems; estimates of future demand for transportation services and their relationship to the national economy; estimates of future transportation investment needs and alternative programs for capital investment provided by States, local governments, and private industry; and studies of system alternatives in urban and intercity transportation, including alternatives for making more efficient use of the existing system as well as for new investment are included. Transportation studies are summarized for each state.

HS-012 880

## 5. VEHICLE SAFETY

### 5A. Brake Systems

#### THE BRAKING OF HEAVY ROAD VEHICLES IN COMBINATION WITH ARTICULATED AND INDEPENDENT TRAILERS

V186 N65

C. E. JohnssonN. G. Dahlkvist

Prepared for presentation to the Institution of Mechanical Engineers, London, 21 Nov 1972.

See serial citation

\*Brake systems, \*Heavy duty vehicles, \*Trailers, \*Brake system design, \*Commercial vehicles, \*Brake balancing, \*Antiskid brakes, \*Spring brakes, \*Valves, \*Great Britain,

A two-line braking system is described as being as safe as and better than the three-line system currently used in the United Kingdom. The method by which this system can be achieved is reported. To maintain the improvement obtained by using a two-line system, spring brakes, emergency operated by means of kick-down release valve, true brake balance using load sensing valves, reliable anti-skid devices, and automatic slack adjusters are discussed.

HS-012 900

### ADAPTIVE BRAKE CONTROL SYSTEM

V186 N68

R. R. GunturH. Ouwerkerk

See serial citation

\*Brake controls, \*Antiskid brakes, \*Wheel slip control, \*Wheel locking, \*Mathematical analysis, \*Forecasting, \*Brake torque, \*Braking forces, \*Deceleration, \*Front wheels, \*Rear wheels, \*Parameters, \*Velocity, \*Recovery time, \*Vehicle stability, \*Mathematical representations,

The brake pressure modulator should have a quick pressure dumping characteristic to make longitudinal velocity of the

be allowed as small as possible. The brake pressure modulator should have a quick pressure rebuild characteristic to improve brake effectiveness at low speeds and on dry roads. The control unit should suit the rate of brake application in the subsequent brake cycles, because there is only one first brake application and many subsequent brake applications during a braking maneuver. The advantages and disadvantages of existing methods of prediction and reselection are studies by means of a numerical example. New conditions for predictions and reselection are proposed and their suitability is examined. A compound condition consisting of two simple conditions is satisfactory for the purpose of prediction. For the purpose of reselection another compound condition consisting of three other simple conditions is satisfactory.

HS-012 901

## 5C. Cycles

### BICYCLE SURVIVAL

V37 N1

H. Krueger

See serial citation

\*Bicycle safety, \*Bicycle riders, \*Traffic laws, \*Bicycle characteristics, \*Bicycle usage, \*Rearview mirrors, \*Reflectors, \*Lighting equipment, \*Inner tubes, \*Pedals, \*Seats,

Information is provided for the beginning bicycle rider on the best type of bicycle to purchase and on optional equipment, including rearview mirrors, lights and reflectors, water bottles, heavy duty inner tubes, seats, pedals, and other accessories. Suggestions for planning a tour, hazards to be avoided, and basic rules of the road for bicycles are presented.

HS-012 896

## 5D. Design

### MEASUREMENT OF THE EXTENT OF ABNORMAL COMBUSTION BY MEANS OF AN EXTERNAL DEVICE

SNAM Progetti (Italy)

G. M. CornettiV. ArrigoniF. SezziG. F. Zanoni SAE-730085  
Presented at International Automotive Engineering Congress,

Detroit, 8-12 Jan 1973.

SAE

\*Combustion, \*Transducers, \*Surface ignition, \*Preignition, \*Knock, \*Autoignition, \*Cyclic pressures, \*Cylinder pressure, \*Vibration, \*Pressure transducers, \*Detonation, \*European vehicles, \*Spark ignition engines, \*Scanning electron microscopes, \*Misfiring, \*Piston failures, \*Combustion chambers,

The detection of cyclic dispersion, knocking, preignition, misfiring, and other phenomena related with abnormal combustion in spark ignition engines has been extensively studied in the past. The transducers most commonly used detect pressure and/or ionization in the combustion chamber. By employing transducers that detect engine head movement it has been possible to examine these phenomena without particular engine modifications, thus enabling measurements to be made in commercial cars. These transducers are used in conjunction with electronic apparatus that gives quantitative measurements of

these means are reported with particular emphasis on high speed knock (a problem presently encountered with European cars), a preignition, and misfiring. On the basis of the test results a technique is developed utilizing the electron scanning microscope to recognize a posteriori, if the piston failure is due to knock or preignition.

HS-012 844

### RELATIONSHIP OF FLAME FRONT PATTERN TO PRESSURE AND HIGH-SPEED KNOCK ON COMMERCIAL ENGINES

Fiat S.p.A. (Italy)

P. ChiampoF. de CristofaroR. Gozzelino SAE-730087

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

\*Combustion, \*Flame propagation, \*Pressure transducers, \*Flame ionization detectors, \*Pressure, \*Knock, \*Fuel properties, \*Oscilloscopes,

The combustion chamber of a typical commercial engines was equipped with pressure and ionization gap transducers to determine the pressure and flame front pattern. The signals from the transducers were displayed on an oscilloscope screen and recorded by a speed-adjustable camera. The necessary data were obtained by measuring the parameters on the single frames which show the combustion cycles, and they were subsequently processed. On the basis of the results reached, the following conclusions can be drawn: there is a correlation between pressure and flame front position, which becomes closer as the percentage of the burned charge increases; dispersions of flame front travel time are greater at combustion start and decrease as combustion expands; knocking cycles are characterized by higher peak pressures and longer flame travel as compared to the respective nonknocking cycles; and knocking start occurs after the flame front reaches the chamber edge, indicating that knock originates in a portion of the charge already crossed by the flame but not entirely burned.

HS-012 846

### TURBULENT FLAME STRUCTURE AS DETERMINED BY PRESSURE DEVELOPMENT AND IONIZATION INTENSITY

SNAM Progetti (Italy)

V. ArrigoniF. CalviG. M. CornettiU. Pozzi SAE-730088

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

\*Flame propagation, \*Combustion, \*Spark ignition engines, \*Pressure transducers, \*Ionization detectors, \*Mathematical analysis, \*Ionization, \*Engine tests, \*Engine speeds, \*Combustion rate, \*Pressure time histories, \*Exhaust emissions, \*Regression analysis, \*Engine operating conditions, \*Fuel quality, \*Flame temperature, \*Heat transfer, \*Turbulence, \*Torque,

Two main properties distinguish the structure of a turbulent flame from that of a laminar flame: ionization current of high intensity and high burning velocity. The first of these two quantities was directly measured in the combustion chamber of a typical European spark ignition engine by means of a Lang-

the experimental data showed that the flame propagation mechanism is consistent with the hypothesis that turbulent combustion is caused by successive self-ignitions, as suggested by Russian authors. Useful information can be obtained from the measurement method used in this work on the quality and quantity of the ions that are the precursors of some pollutants found in the exhaust stream of a spark ignition engine.

HS-012 847

## AN INVESTIGATION OF SERIAL CHOICE REACTION TIME AS THE BASIS FOR AN ALCOHOL INTERLOCK

Ohio State Univ.

For primary bibliographic entry see Fld. 3D.

HS-012 849

## AN INVESTIGATION OF SERIAL CHOICE REACTION TIME AS THE BASIS FOR AN ALCOHOL INTERLOCK

Ohio State Univ.

For primary bibliographic entry see Fld. 3D.

HS-012 849

## NEW AUTOMATIC TRANSMISSION FOR OFF-HIGHWAY VEHICLES

V81 N4

Based on SAE-730442, An Automatic Transmission for Off-Highway Vehicles, by K. B. Harmon and J. W. Schmidt, General Motors Corp.  
See serial citation

\*Automatic transmissions, \*Off the road vehicles, \*Automatic transmission design, \*Gear shifting mechanisms, \*Torque converters, \*Heavy duty vehicles, \*Commercial vehicles, \*Clutches, \*Lubrication systems, \*Cooling systems, \*Lubricating oils, \*Power takeoff equipment, \*Retarders, \*Hydraulic valve lifters, \*Valves, \*Transmission tests, \*Laboratory tests, \*Field tests,

Automatic transmission design for heavy duty commercial vehicles is discussed. Lubrication and cooling systems, power takeoff provisions, retarder operation for grade descent, hydraulic shift control, shift-signal and relay valves, and trim and boost valving for automatic transmission vehicles are described. Laboratory tests were performed, and field tests were conducted for vehicles operating on normal duty in order to develop transmission reliability.

HS-012 894

## ANALYSIS AND MEASUREMENT OF THE RELATIVE MOVEMENTS BETWEEN THE ROAD WHEELS OF A VEHICLE AND THE ROAD SURFACE

V186 N57

D. M. Butler, J. R. Ellis

See serial citation

\*Suspension systems, \*Vehicle road interface, \*Tire road contact forces, \*Vehicle handling, \*Velocity, \*Pitch, \*Roll, \*Steer-

real suspensions for all possible positions of the suspensions in a manner which relates the wheel movements directly to the body motions. The roll center concept is discarded, with the result that the wheel movements, and hence tire forces, which were masked by the limitations of the roll center assumptions, are now available for examination and inclusion in any vehicle study. This has resulted in the development of more realistic models of vehicle ride and handling including anti-drive attitudes and other phenomena.

HS-012 897

## A NEW CLASS OF ROTARY PISTON MACHINE SUITABLE FOR COMPRESSORS, PUMPS AND INTERNAL COMBUSTION ENGINES

V186 N62

J. M. Clarke, D. F. Walker, P. H. Hamilton

Prepared for presentation to the Institution of Mechanical Engineers, London, 18 Oct 1972.  
See serial citation

\*Rotary piston engines, \*Engine design, \*Rotors, \*Seals, \*Ports (openings), \*Engine tests, \*Leakage, \*Wankel engines, \*Mathematical analysis, \*Inertial forces,

The mechanisms and porting requirements of a new class of rotary piston machine are described. The machines can be regarded as a generalization to three dimensions of that class of planetary motion machine which includes the Wankel. Important features of the Wankel engine are retained, namely a compact arrangement, a sliding contact seal grid, and multiple chambers on each rotor, but these new machines have twice as many chambers on each rotor, and they apply results of three-dimensional rigid body dynamics to select piston motions which involve very low inertial forces. An experimental engine is described with some results.

HS-012 898

## PREDICTING DIESEL ENGINE PERFORMANCE AT VARIOUS AMBIENT CONDITIONS

International Harvester Co.

T. Wu, K. J. McAulay SAE-730148

Presented at International Automotive Congress, Detroit, 8-12 Jan 1973.

SAE

\*Diesel engines, \*Engine performance, \*Forecasting, \*Mathematical analysis, \*Ambient temperatures, \*Steady state, \*Smoke, \*Engine speeds, \*Turbochargers, \*Engine tests, \*Thermal efficiency, \*Power output, \*Air fuel ratio, \*Engine operating conditions,

A semiempirical method is developed for predicting steady state power, smoke, exhaust temperature, and turbocharger speed of diesel engines (naturally aspirated, turbocharged, or turbo-intercooled) over a range of ambient conditions at constant fuel rate and engine speed. The basic assumptions, derivations, and a comparison of calculated predictions with test data are presented. A method of including the effect of fuel temperature on engine power is also given.

HS-012 902

## BONDING PROCESSES IN AUTOMOTIVE MANUFACTURE

Chrysler Corp.

G. O. DeFrayne S. B. Twiss SAE-730136

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.  
SAE

\*Bonding, \*Automobile manufacturing, \*Adhesives, \*Fillers, \*Curing, \*Disc brakes, \*Brake pads, \*Brake shoes, \*Hoods, \*Windshield mounting, \*Roofs, \*Solders, \*Sealers, \*Plastics, \*Leakage tests, \*Durability tests, \*Surface treatment, \*Cleaning,

Five bonding processes used in the automotive industry, ranging from structural adhesive to nonstructural and filler, are discussed. Surface preparation, including use of primers; nature, application, and curing of adhesive; secondary processes; in-line testing and destructive test methods; and repair processes are covered. The integral bonding of disc pad shoe assemblies is detailed. Vinyl plastisol adhesives are used for bonding assemblies. Windshield and backlight bonding is a semistructural adhesive application. Contact bonding cements bond exterior vinyl roof covering to roof panels. A vinyl plastisol sealer replaces solder on the joint between the roof and rear quarter panel.

HS-012 905

## AUTOMOTIVE TAPE RECORDER. VOL. 3. ASSEMBLY, INSPECTION AND PRE-CALIBRATION. FINAL REPORT

AVCO Corp.

AVSD-0135-72-CR

Report for Feb-Nov 1972.

NTIS

\*Tape recorders, \*Calibration, \*Manufacturing inspection, \*Manufacturing, \*Performance tests, \*Sensors, \*Test equipment, \*Magnetic tapes, \*Pressure transducers, \*Accelerometers, \*Specifications, \*Instrumentation, \*Flow charts,

Procedures are outlined for assembly, pre-assembly, and in-process inspection, pre-calibration, and acceptance testing of the Automotive Tape Recorder. The assembly facility, requirements, and procedures for production of quantities from 5,000 to 50,000 units are discussed.

HS-012 807

## REAR END STRUCTURAL CRASHWORTHINESS OF UNITIZED CONSTRUCTION VEHICLES, DESIGN DEVELOPMENT AND DESIGN VERIFICATION. FINAL REPORT, PT. 2

Dynamic Science

R. L. Anderson E. Enserink 2310-73-22

Report for Jul 1972-Jan 1973.

NTIS

\*Crashworthiness, \*Energy absorbing rear structures, \*Unitized body construction, \*Vehicle vehicle impact tests, \*Barrier collision tests, \*Sheet metal, \*Polyurethane foams, \*Inflatable head restraints, \*Restraint system tests, \*Rear end impact tests, \*Model tests, \*Scale models, \*Test facilities, \*Dynamic tests, \*Static tests, \*Test equipment, \*Data acquisition, \*Data reduction, \*Automobile design, \*Angle impact

tests, \*Acceleration response, \*Automobile modification, \*Crush tests, \*Deformation, \*Accelerometers, \*Displacement, \*Impact forces,

The object of this program was to develop a rear end structure with improved crash energy control characteristics for late model unitized construction American built automobiles. The design effort utilized information obtained from full-scale baseline tests and scale model tests to generate vehicle modifications intended to meet the program design goals. Two energy absorbing concepts, polyurethane foam and stiffened sheet metal, were integrated into crashworthy rear end designs. Two development tests of each design were performed. The foam modification was eventually selected for the angle barrier and vehicle-to-vehicle verification testing. Several designs of inflatable head restraints developed under another NHTSA contract were also tested in this program.

HS-800 816

## SF. Fuel Systems

### MIXTURE TURBULENCE--A KEY TO CYCLIC COMBUSTION VARIATION

Michigan Univ.

R. E. Winsor D. J. Patterson SAE-730086

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

\*Spark ignition engines, \*Turbulence, \*Fuel mixtures, \*Combustion chamber swirl, \*Cyclic pressures, \*Cylinder pressure, \*Anemometers, \*Calibration, \*Air fuel ratio, \*Heat transfer, \*Wire, \*High temperature, \*Pressure transducers, \*Oscilloscopes, \*Combustion rate, \*Flowmeters, \*Flame propagation, \*Ignition, \*Fuel mixture temperature, \*Fluid flow, \*Engine speeds, \*Mathematical Analysis, \*Models,

Cyclic combustion variations were studied in a single-cylinder Cooperative Fuel Research engine with a pancake combustion chamber. Variations in combustion duration were related to mixture velocity and its variations through a simple model. This model postulates a critical flame radius increment in which mixture motion variations near the spark electrodes create the cyclic combustion variations. From experimental measurements, the critical flame increment in this engine was found to be about 0.4 inches. Mixture motion measurements were made with a hot-wire anemometer in the engine motored without fuel. A new calibration and calculation technique was developed to obtain velocities from the anemometer output in the varying temperature and pressure environment of the engine. Tests were run at full and part load over the speed ranges of 500-1500 rpm. Near top dead center the turbulence in the engine was isotropic and the turbulent velocity increased linearly with engine speed.

HS-012 845

## HYDROGEN AS A FUEL AND THE FEASIBILITY OF A HYDROGEN-OXYGEN ENGINE

Calgary Univ. (Canada), C00500 Firestone Tire and Rubber Co. of Canada Ltd.

G. A. Karim M. E. Taylor SAE-730089

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

\*Hydrogen fuels, \*Oxygen, \*Spark ignition engines, \*Mathematical models, \*Engine performance, \*Exhaust gas recirculation, \*Reaction kinetics, \*Autoignition, \*Computerized simulation, \*Combustion, \*Exhaust emission control, \*Thermal efficiency, \*Fuel mixtures,

A preliminary investigation was made into the use of hydrogen-oxygen mixtures in spark ignition engines. Following a literature survey regarding the combustion characteristics of hydrogen, a computer program based on a constant-volume combustion engine cycle was used to evaluate the overall engine performance. Another program, which considered chemical reaction kinetics, was used to predict the onset of autoignition in mixtures undergoing compression in an engine. Results of the program indicated that an attractive and safe way to use hydrogen-oxygen mixtures in an engine involved the recycling of exhaust gases. Such a system would be fed with a stoichiometric mixture, while excess hydrogen would be circulated within to control combustion in the engine. Water vapor would be condensed from the exhaust gases and would be the only product leaving the system.

HS-012 848

## SJ. Lighting Systems

### EVALUATION OF REAR-END COLLISION DATA FOR DETERMINING VEHICLE REAR-LIGHTING AND SIGNALING PRIORITIES

V3 N4

R. G. MortimerD. V. Post  
See serial citation

\*Rear lamps, \*Rear end collisions, \*Accident prevention, \*Accident severity, \*Light conditions, \*Controlled access highways, \*Parked vehicles, \*Day vs night accidents, \*Vehicle vehicle collisions, \*Accident causes, \*Turning, \*Michigan, \*Car following, \*Distance perception, \*Motion perception,

Using the Washtenaw County (Michigan) Accident-Data files, an analysis of rear end collisions involving two or more vehicles was carried out to assist in the development of vehicle marking and signaling systems, by associating the relative frequencies of such injury-producing collisions with the action of the vehicle struck. On county roads and city streets, vehicles moving straight or stopping were struck about five times as often as those turning. On limited access highways, vehicles were struck most often when moving straight, with greater relative frequency at night than during the day. At night, parked vehicles were struck more often than turning vehicles. Better marking or signaling for turning vehicles was indicated on roads and streets, while driver aids for determining relative velocity, closure, and distance are needed on limited access highways. The recognition of parked vehicles at night must be improved.

HS-012 885

## SL. Manufacturers, Distributors, And Dealers

### THE ACCOUNTABLE ENGINEER. PRESIDENTIAL ADDRESS

V186 N64  
D. G. Stokes

Prepared for presentation to the Institution of Mechanical Engineers, London, 25 Oct 1972.  
See serial citation

\*Automotive industry, \*Engineers, \*Professional role, \*Automobile costs, \*Vehicle design, \*British Leyland Motor Corp. Ltd.,

The automotive engineer is responsible for identifying and meeting the needs of the market place and for making a profit on the capital employed in the business. Using the Austin Morris Group at British Leyland Motor Corp. Ltd. as an example, the role of the engineer in planning vehicle design, methods of production, and required manning levels is outlined.

HS-012 899

## SN. Occupant Protection

### INVESTIGATION REPORT OF THE FIRST AIR-BAG DEPLOYMENT IN A REAL-WORLD ACCIDENT

Ford Motor Co.

For primary bibliographic entry see Fld. 1C.

HS-012 860

### PULMONARY VENTILATION AND ENERGY EXPENDITURE IN CAR DRIVING WITH AND WITHOUT SEAT BELTS

Fiat S.p.A. (Italy)

For primary bibliographic entry see Fld. 3D.

HS-012 865

### TECHNIQUES TO DETERMINE OCCUPANT RESTRAINT USAGE AND THE EFFECT OF IMPROVED RESTRAINT SYSTEMS ON USAGE

Automobile Club of Southern California

M. R. ApplebyL. J. Bintz

In HS-012 850

\*Seat belt fastening warning systems, \*Seat belt usage, \*Warning system effectiveness, \*Driver monitoring, \*Electronic monitoring systems, \*Seat belt regulations,

A study was conducted to determine the effectiveness of seat belt fastening warning systems. Seat belt usage was measured using an electro-mechanical device which counted the number of times the seat belt was used compared to the number of vehicle trips. Thirty-five vehicles were monitored. The results show that as a result of the reminder system seat belt usage increased from an average of 25.5% to 68.4%; only one test subject showed negative improvement; 18 test subjects who wore seat belts for no or low percent of trips increased their average usage from 1.2% to 54.4%; and 17 test subjects who were seat belt users increased their average usage from 51.3% to 83.3%. These results suggest that seat belt reminder systems could prove to be a viable alternative to passive or semi-passive restraints and compulsory seat belt use legislation.

HS-012 878

### TOXICITY EVALUATION OF CRASH RESTRAINT GAS GENERATORS

Rocket Res. Corp.

E. W. Schmidt

In HS-012 850

\*Air bag restraint systems, \*Toxicity, \*Augmented gas inflation devices, \*Gas generators, \*Aspirator inflation devices, \*Stored

## Category 5N—Occupant Protection

devices, \*Compressed gases, \*Solid propellants, \*Implosion, \*Animal experiments, \*Chemical analy-sols, \*Tolerances (physiology), \*Anoxia, \*Asphyxia, hazards, \*Postcrash phase, \*Oxygen, \*Nitrogen, \*Amine igniters,

Air bag inflation systems now in use are briefly described and compared. In evaluating air bag restraint systems, potential toxicity of exhaust products from the inflation devices and air dilution with subsequent lack of oxygen have to be considered. The rationale used in establishing safe limits for all exhaust products from gas generators is discussed. Animal exposure tests with pyrotechnic gas generators are described. The problem of air dilution in a closed car is given special attention.  
HS-012 879

**IMPACT TESTS OF HUMAN SUBJECTS USING A PROTOTYPE AIR BAG RESTRAINT SYSTEM. FINAL REPORT**

Aerospace Medical Res. Lab. (65737)  
C. R. GreerH. C. Russell AMRL-TR-72-97  
NTIS

\*Air bag restraint systems, \*Barrier collision tests, \*Restraint system tests, \*Occupant kinematics, \*Human body impact tolerances, \*Test volunteers, \*Anthropometric dummies, \*Front seat passengers, \*Test equipment, \*Energy absorbing instrument panels, \*Test facilities, \*Instrumentation, \*Transducers, \*Accelerometers, \*Data processing, \*Injury severity index, \*Acceleration response, \*Head acceleration tolerances, \*Chest acceleration tolerances, \*Impact velocity, \*Restraint system effectiveness, \*Deceleration, \*Enzymes, \*Blood analysis, \*Harnesses, \*Eyeglass impact tests, \*Rebound,

Seven barrier impacts were studied using 13 healthy young male volunteers seated in the right front passenger position. Data were collected at impact velocities ranging from 15.1 to 31.5 mph. The reliability of the prototype air bag restraint system tested was 0.973 at 90% confidence based on no failures. The interaction of subjects with the air bag was not significantly altered by a safety harness. The air bag began to deploy from 41.6 milliseconds at 10 g to 21.8 milliseconds at 22 g after initiation of the deceleration pulse at the water brake. Head and chest impact and rebound accelerations and head impact and rebound severity indexes were calculated. There was little difference in myocardial enzyme levels for the 10 subjects so studied. Trauma was more common at higher sled decelerations, varying from no injury to minor combinations of erythema, abrasion, contusion, and blisters. Results of eyeglass impact tests are reported.  
HS-800 805

**REAR END STRUCTURAL CRASHWORTHINESS OF UNITIZED CONSTRUCTION VEHICLES, DESIGN DEVELOPMENT AND DESIGN VERIFICATION. FINAL REPORT, PT. 2**

Dynamic Science  
For primary bibliographic entry see Fld. 5D.  
HS-800 816

## 5O. Propulsion Systems

### AUTOMOTIVE STEAM POWER: WHERE IT STANDS TODAY

V81 N4

Based on SAE-730617, Automotive Steam Power--1973, by A. W. Gardiner, Tennessee Technological Univ.

See serial citation

\*Steam vehicles, \*Exhaust emission control, \*Rankine cycle engines, \*Combustion, \*Power plants, \*Exhaust emission tests, \*Fuel consumption, \*Steam condensers, \*Rankine cycle engine fluids, \*Freezing, \*Expander design, \*Cylinders, \*Lubrication, \*Boilers, \*Thermal efficiency, \*Steam turbines, \*Water,

The cost, complexity, and low efficiency of highly controlled conventional engines are beginning to make the Rankine-cycle powerplant more practical for automotive use. The slow, continuous, low pressure combustion process of steam engines reduces exhaust emissions. Projects to improve Rankine components have been financed by the government and private industry, and the Environmental Protection Agency is funding four Rankine cycle powerplant projects, two which use water as the working fluid and two of which use organic fluids. Two of the powerplants will use reciprocating expanders and two will use turbines. The development of high performance condensers, steam expanders, boilers and controls, cylinder lubrication, and thermal efficiency, and the properties of working fluids are discussed.  
HS-012 892

## ST. Trucks And Trailers

### CLINICAL EVALUATION OF INJURIES RELATED TO SNOWMOBILES

For primary bibliographic entry see Fld. 1B.  
HS-012 852

### COMMERCIAL VEHICLE FRONT-TIRE FAILURES

Bureau of Motor Carrier Safety  
For primary bibliographic entry see Fld. 5V.  
HS-012 883

### MOTOR CARRIER ACCIDENT INVESTIGATION. GORDON TRANSPORTS, INC. ACCIDENT--MARCH 16, 1972--BROOKLYN, OHIO

Bureau of Motor Carrier Safety  
For primary bibliographic entry see Fld. 1C.  
HS-012 887

### THE BRAKING OF HEAVY ROAD VEHICLES IN COMBINATION WITH ARTICULATED AND INDEPENDENT TRAILERS

For primary bibliographic entry see Fld. 5A.  
HS-012 900

## 5V. Wheel Systems

### COMMERCIAL VEHICLE FRONT-TIRE FAILURES

Bureau of Motor Carrier Safety  
Corporate author

ire failures, \*Front tires, \*Truck tires, \*Accident investigation, \*Tire failure caused accidents, \*Accident statistics, \*Commercial vehicles, \*Tire load limits, \*Axle loads, \*Tire inflation pressure, \*Tire standards, \*Tire manufacturer codes, \*Fire temperature, \*Tire sizes, \*Tubeless tires, \*Tire tread depths, \*Tire wear measurement, \*Vehicle mileage, \*Missouri,

Tire failures are the second leading cause of mechanical defects in vehicles. Front-tire failure accidents account for over 60% of these accidents. A two-day check of 576 vehicles was conducted at the scales on Interstate 70 in Odessa, Missouri. Forty-four of the 576 vehicles had their weight and tires checked in total. The percentage of trucks with overloaded front tires was between 3.9 and 13.6%. Four and one-half times as many front tires were underinflated as were overloaded. Right front tires fail more often than left front. There is no indication that tubeless tires are less apt to be involved in front tire failure accidents. Tires involved in such accidents have slightly less tread pattern depth than do other front tires. Worn tread is not a major cause of front tire failures. Mileage on 61 tires which failed, is graphed, and suggestions for preventing tire failures are presented.

HS-012 883

#### RE TRACTION RESEARCH

3 N4

T. Tielking  
Supported by Motor Vehicle Manufacturers Assoc.  
e serial citation

\*Tire traction, \*Tire research, \*Tire tests, \*Tire performance, performance tests, \*Skid resistance tests, \*Cornering, \*Braking forces, \*Pneumatic tires, \*Tire road conditions, \*Wet road conditions, \*Road tests, \*Tire side forces, \*Tire slip motion, \*Tire pavement interface, \*Deformation analysis, \*Shear stress, \*Simulation models, \*Tire inflation pressure, \*Tire loads, \*Tire profile measurement, \*Water depth,

representative tire data are presented to illustrate two approaches to traction testing: wet testing for limit performance capability and combined braking-cornering tests to gain a more complete understanding of tire behavior. A semiempirical model developed at the Highway Safety Research Institute to simulate combined braking-cornering traction characteristics is discussed. The simulated traction curves are compared with experimental test data.

HS-012 886

#### MOTOR CARRIER ACCIDENT INVESTIGATION. ORDON TRANSPORTS, INC. ACCIDENT--MARCH 1972--BROOKLYN, OHIO

Bureau of Motor Carrier Safety  
For primary bibliographic entry see Fld. 1C.  
HS-012 887

#### MECHANICAL PROPERTIES OF RADIAL TIRES

General Motors Corp.  
G. Peterson R. E. Rasmussen GM-E-P-5080  
Prepared for presentation to the Akron Rubber Group, 27 Oct  
72.

Corporate author

Steel belted tires, \*Tire mechanics, \*Tire performance, \*Steel belted tires, \*Vehicle handling, \*Tire sizes, \*Tire load limits, \*Tire slip motion, \*Cornering, \*Camber, \*Lateral force, \*Tire

forces, \*Understeer, \*Torque, \*Tire uniformity, \*Tire spring rates, \*Vehicle riding qualities, \*Spectral analysis, \*Tire traction, \*Tire noise, \*Power loss, \*Bias belted tires, \*Tire tests,

For new tires, vehicle/tire system performance is mainly influenced by mechanical properties. Dimensions, handling, ride, traction, noise, and power loss performance of steel belted radial tires are evaluated and compared with bias belted tires.

HS-012 891

#### TIRE CORNERING/TRACTION TEST METHODS

Ford Motor Co.

C. Beauregard R. G. McNall SAE-730147

Presented at International Automotive Engineering Congress,  
Detroit, 8-12 Jan 1973.  
SAE

\*Tire traction, \*Tire performance, \*Cornering, \*Tire tests, \*Tire test equipment, \*Trailers, \*Towing, \*Instrumentation, \*Transducers, \*Calibration, \*Braking, \*Lateral force, \*Tire loads, \*Tire slip motion, \*Torque, \*Tire road conditions, \*Wet road conditions, \*Dry road conditions, \*Steady state, \*Tire inflation pressure, \*Camber, \*Radial tires, \*Bias belted tires,

A tire cornering/traction trailer designed to measure the traction and steering performance of passenger car tires was developed. A general set of specifications is given for the entire test system. The major subsystems described are the trailer with its versatile suspension; the tow vehicle and its performance capabilities; the transducer system which measures the normal load, lateral force, fore-and-aft force, aligning torque, steer angle, and speed; and the instrumentation. The calibration method is discussed. Test methods for straight-line braking, maximum lateral traction, steady state and transient steering response, and combined braking and cornering traction are outlined.

HS-012 903

#### RATING TRACTION AND WEAR--A REVIEW

Cornell Aeronautical Lab, Inc.

SAE-730145

Presented at International Automotive Engineering Congress,  
Detroit, 8-12 Jan 1973.  
SAE

Existing methods of measuring tread wear, including laboratory tests of small samples, tire indoor and road tests, tread depth loss versus weight loss, and radiation methods, and the development of a wear index are reviewed. Methods of measuring traction and the applicability of tread wear and traction measurement to tire grading if performed on an indoor facility with a simulated roadway are discussed. Indoor testing would assure accurate control of all performance parameters, rapid collection of data, and effective exploration of new test cycles and rating systems. 137Tire traction; Tire treads; Tire wear measurement; Tire tests; Wear tests; Laboratory tests; Road tests; Tire tread depths; Tire wear resistance; Radiation; Tire performance; Tire grading; Tire forces; Lateral force; Tire road conditions; Wet road conditions; Braking; Cornering  
HS-012 904

#### FEASIBILITY STUDY OF TRAILER TECHNIQUES FOR TIRE TRACTION. VOL. 2. FINAL TECHNICAL REPORT

Goodyear Tire and Rubber Co.

## Group 5V—Wheel Systems

A. F. Ramsey J. D. Eagleburger S. R. Sacia

Report for Apr 1972-Jan 1973.

NTIS

\*Tire traction, \*Trailers, \*Tire tests, \*Braking forces, \*Skid resistance tests, \*Coefficient of friction, \*Tire loads, \*Tire inflation pressure, \*Water depth, \*Speed, \*Tire slip motion, \*Instrumented vehicles, \*Statistical analysis, \*Tire road conditions, \*Tire wear measurement, \*Data reduction, \*Calibration, \*Test facilities, \*Tire test equipment, \*Transducers, \*Wet road conditions,

A nine-month test utilizing a two-wheeled towed traction trailer

was conducted to evaluate the existing methodology for determining the relative braking traction characteristics of a production test tire and an American Society for Testing Materials control tire. The test included segments designed to determine the repeatability of the test procedure and apparatus and to evaluate the effect of tire load, tire inflation pressure, road speed, road surface coefficient of friction, and surface water depth. Statistical techniques are employed to analyze the data with respect to the test reliability. The influence of the varied test parameters is presented in tabular and graphic form. Refinement of the two-wheeled trailer traction measurement is discussed.  
HS-800 812



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